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Consciousness as a Function of Knowledge and Culture

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Abstract

The study of consciousness requires a language for exact and precise communication. This article presents a study of how workers in various cultural contexts value information of relevance to their job performance. The strategy of analysis applied differs radically from the classical approaches. Based on the concept of coordinative structure, functional linkages among textual Agents and Objectives provide for the emergence of mental phenomena. The experimental subjects were 35 randomly selected mechanics from Sweden, England, West Germany, Italy, and United States. Their verbal responses to three open questions were analyzed. Only significant groupings that do not fall below the lower limit of $t_{.90}$ of the t-distributions are retained in the analysis. The subjective consciousness embedded in the texts is visualized in a three-dimensional cubic space. The results are discussed with respect to the cognitive process depicted in the phase space. The experimental variable has given rise to different mental structures. A comparison of what seems to be prototypical of these cultural contexts shows a spectrum from economic matters to basic questions of morality.

Within the social sciences, an ever growing number of studies have in some way or the other a need for obtaining verbalized observations from their subjects. By this is meant that here we are no longer concerned with relations among " observables " but with observations in Wigner's (1969) sense. The reason for this change from collecting data obtained by rating scales to the production of unrestricted text is a felt necessity to account for various cultural contexts and environments. Consequently, an unrestricted flow of ideas and the expression of opinions in natural language is preferred to the processing of scores with models of known processing capacity. The implicit assumption underlying this approach may be stated by the following premise:

> What humans observe as essential for becoming conscious of their environment is accentuated by their verbal observations (1)

A representation of verbalized observations presupposes a perspective as well as the specification of a structure. Every verbal description contains objective knowledge, but has to depict its crucial structural qualities in such a way that intentionality and orientation can be captured. When the purpose is to analyze knowledge, it is central to differentiate between a subjective and an objective component (De Mey, 1982). By applying the schema model, as outlined in Bierschenk (1984), it is assumed that the cooperative actions taken by people in their cultural context require that the synthetic instead of the analytical proposition be accounted for. This entails a second premise:

> Natural language is the means to express an intentional and oriented schematization process (2)

The discussion thus far may be summarized by the following formula:

> Agent → action → Objective (3)

Formula (3) incorporates the schema model, which imposes a constitutive function on the context. Its assumptions are:

1. The perspective of the agent governs the choice of viewpoints, which means that the perspective is latent in the verbal flow.
2. The viewpoints are selected to describe objects and events within a specified context.
3. The information embedded in the structure represented becomes accessible only in relation to activated components. The kind of observation manifested in a verbal expression depends on what is being realized through the action component.

The generation of knowledge and its representation presuppose models which manipulate the Objective component in the information processing. The information gained consists of known facts, that is, propositional knowledge and conditions. Information processing based on a sequence of operations on propositional knowledge, that is, conditionalized actions, may seem efficient or rational, but can hardly extract or abstract the perspective structure underlying the verbalization of an observation.

At times, the properties of the text produced indicate that factual knowledge is sparsely distributed, a circumstance that points towards its subordinate import. The function of such a text is merely to emphasize the perspective of the producer. It is very common that researchers in the social sciences have to deal with this kind of text material, and even more common that they must approach vast quantities with so called " unstructured " verbal responses. This fact creates nearly unsurmountable difficulties when it comes to scientific analysis. These difficulties can be overcome, but not unless a radically new position in designing a strategy for text processing is taken.

The purpose of this article is to demonstrate the realizability of a strategy that can

1. on the basis of a few coordinatively operating basic components differentiate between viewpoints and perspective,
2. function as a basis for the construction of an algorithmically working system, and

3. identify an agent function as foundation for winning meaningful conceptual relations.

This process always comprises on the one hand random language elements with more or less frozen syntactic form, and constitutive principles on the other. If chance shall be discriminable from a principled order (Pribram, 1986), then a paradigmatically founded theory is needed. This paradigmatic foundation as basis for the strategy proposed rests on formula (3) and has been presented in Bierschenk (1982) and Bierschenk & Bierschenk (1976). The methodological approach presented in Bierschenk & Bierschenk (1986, a, b, c) has three distinctive advantages:

1. It is not bound to type of text or length of text.
2. It is applicable to at least European languages.
3. It is programmable.

The application of this strategy requires text processing within a multivariate analysis system, if meaningful conceptual relations shall be discovered.

In the following we will present the representation of structural relations in verbal observations from Swedish, English, West German, Italian, and US workers of a multinational machine industry. Based on data matrices suited for multivariable analysis, cluster analyses have been carried out to represent verbal observations as a function of textual transformation and change. The results will be graphically displayed and discussed with respect to their conceptual structure. By keeping the perspective structure separated from the structure of the viewpoints, the method used will demonstrate textual transformation in the form of a cubic space. By means of the topographical representation, it will be shown that text production is not only a divergent process, but will be characterized by distinct cognitive phases, at times.

Method

Subjects

A Swedish multinational industry with companies in various geographical areas of Europe and overseas has carried out an extensive survey. Their goal population amounts to about 30-40

thousand persons. The accessible population was estimated to about 12-15 thousand mechanics. From this population, about 4-5 thousand individuals were selected by the representatives of the companies. The material was divided up into the following cultural contexts: Sweden, England, West Germany, Italy, and the United States. Thus the cultural context functions as experimental variable in the analysis. It turned out that only 7 Swedish subjects have produced useful unrestricted verbal responses. The responses relate to three open-ended questions about information management and use. Therefore, 7 subjects were randomly selected from the other cultural contexts to match the Swedish sample.

Material

The three questions posed to the workers have been translated by the industry. Because of variations in the wording, the versions in the various languages will be given in extenso:

Question 1.

Swedish: Har du några ideer/förslag på hur man kan få samtliga mekaniker att använda servicehandböckerna?

English: Do you have any ideas/suggestions how to encourage more mechanics to use the service manuals?

German: Haben Sie eigene Ideen/Vorschläge, wie man alle Machaniker zum Gebrauch der Service-Handbücher anregen kann?

Italian: Hai suggerimenti su come stimulare l'interesse alla lettura dei manuali di servizio, da parte dei meccanici?

Question 2.

Swedish: Har du något förslag på hur informationen till dig kan förbättras?

English: Do you have any suggestion how getting information to you can be improved?

German: Haben Sie einen Vorschlag, wie man die Nachrichtenübermittlung zu Ihnen verbessern kann?

Italian: Hai qualche proposta su come migliorare il sistema di trasmissione delle informazioni al personale d'officina?

Question 3.

Swedish: Tycker du att det sänds ut för mycket papper (information)?

English: Do you think too much (or too little) paper (information) is sent out?

German: Sind Sie der Meinung, dass zu viel Papier (Information) ausgeschickt wird?

Italian: Trovi che il materiale informativo inviato alle officine sia eccessivo?

These questions highlight different aspects of import to the management and selective dissemination of information. To counterbalance the variations in translation, they have been treated as if one question was posed. Some authentic responses will now be reproduced to give the reader an impression of the kind of text analyzed.

Swedish text. " Ta väck ackordlönesystemet så att det finns tid att läsa handböcker = bättre utfört jobb ". (Response to question 1.)

English text. " Far too much sent out. Judging by the amount of bulletins sent out on the [A model] I would suspect that it was not properly developed ". (Response to question 3.)

German text. " Bei uns im Betrieb werden die Mechaniker immer aufgefordert, regelmässig in die Handbücher hineinzuschauen. Es wird auch viel mit den Büchern gearbeitet ". (Response to question 1.)

Italian text. " Di farle più semplificate perché da noi in bassa Italia in media siamo pochi a riguardo la scuola almeno per ciò che riguarda della mia età ". (Response to question 2.)

United States text. " I don't think too much paper information can ever be provided. For most of the technicians this is probably the only method by which they may stay informed ". (Response to question 3.)

The attributes of the material are usually considered of great importance for the definition of what is informative for processing. Especially with artificially defined materials, experimentors are very careful in reporting the surface features, because these seem to be of import for their formulation and generation of knowledge. In our case, the surface features are comparatively unimportant, because we are working with a naturally produced text, which is characterized by a structure existing beyond what can be composed or computed by organizational connections.

Design and Procedure

The basic premise on which all scientific observation rest is that processes can be isolated and studied with respect to their structural stability. It was stated (3) that prototypical forms are observable and that any consciousness that can be formalized into an expression such as

(A a (A a O, A a O, ...)) (4)

states that prototypical forms are recurrent. The formulas (3) and (4) indicate transference, which means that the AaO's of the text cooperate in order to lift the information from its syntactic carriers. This requires the modelling of the AaO's such that they can be formalized with respect to the following basic components:

Agent: denotes an action center, i.e., the point of reference for an observation. It is the intentional and thus most basic component without which no action can whether occur nor be controlled.

Action: denotes the intentional character of an observation expressed. Thus the action is instrumental for the Agent in coordinating the observations.

Objective: denotes the final point for the action and has the following subcomponents:
Figure: denotes the point of intention.
Ground: denotes the point of orientation.
Means: denotes the instrument of an observation.
Setpoint: denotes the limit of an observation.

The procedural processing of running text will be exemplified on the first sentence of the US text example. Table 1 illustrates that every textual element gets its unique code assigned to it. The first figure in the code addresses structural or dynamic properties, while the second one represents more static, i.e., descriptive information. The output of this type of processing constitutes the input for matrix construction. Every 30 code within the boundaries of a 01 or 00 code makes up the rows of a matrix,

while all 50 codes constitute the columns of that matrix. Consequently, every realization of a structural relation can be distinguished and counted. With respect to the material, matrices have been built up of the Figure, and the Ground components for each of the five cultural contexts separately. The relational affinity between the Agent and the Objective components is defined by the Action component, that is, every time a 40 code relates an A to an O, affinity is marked, otherwise independence. A consequence for the matrix generation is that a not explicitly stated Agent implies an X-variable, while an absent Objective implies an Y-variable.

In order to specify the linkage in a group of textual Agents whose activities covary as a result of shared Objectives, every relation is assigned the binary code 1 independent of its frequency. All other cells in the matrix are assigned a 0 code. For the reading in of the observed relations a protocol is set up in which all relevant columns for a certain Agent are given. On

Table 1. Formatting of text

Text Data	Code	Text Data	Code
.	00	information	50
[att]	01	[att]	01
I	30	(too)	51
do	40	(much)	52
n't	50	(information)	50
[att]	01	is	40
(I)	30	sent	40
think	40	out	50
too	51	(X)	30
much	52	.	00

Note: The rules for processing and the scheme for formatting are given in Bierschenk & Bierschenk (1986, b,c).

the basis of the protocol, a computer program builds up the matrices as input for cluster analysis. This method is especially suited when we can assume affinity instead of the usual independence. A variety of grouping methods of a data set can be executed according to various principles. The principles of relevance are partly a successive agglomeration of elements, partly the definition of an optimization criterion for governing the grouping process. The mechanics of the analysis permit the discovery of coordinative structures of the Agents, which is a prerequisite for discovering the perspectives of the texts. Further, the relations between the grouped Objectives of the texts can be discovered, which means that we can state the coordinative structure of the viewpoints.

The first step in the analysis of the matrices requires the choice of a clustering algorithm. Among the procedures available, Ward's (1963) method seems to be sufficiently reliable for binary data. He suggests the computation of the loss of information at every step in an iteratively working grouping process. His opinion is that loss of information can be measured by the total sum of the squared deviations of the points (Agents, Objectives) from the mean value of the cluster to which the respective point belongs. At every step in the analysis, the algorithm computes a union of every possible pair of clusters and agglomerates those two clusters whose combination results in a minimum loss of information. The algorithm builds on an updating of a squared Euclidian matrix of distances between cluster centroids. The solution of the clustering results in a hierarchical organization with quantitative estimations of a loss of information at every level in the hierarchy. The minimum increase of the error sum of squares is proportional to the squared distance between the centroids for the agglomerated groups. This result differs from the centroid method in that Ward's method implies a weighing of the distance between the centroids when the distance is computed. The computational procedure has been executed with Wishart's (1982) CLUSTAN program.

Results

When an analysis of the experimental texts takes its point of departure in the schema model (formulas (3) and (4)), a strict dependency between textual elements becomes visible. The model may therefore be used for a transference and extraction of conceptual relations and their descriptions. The capacity of the schema model to synthesize successive segments in a progressive development of a text is founded on the steering and control function of the Agent component. It controls perspective and change in perspective at the same time as it indicates which intention is operating on the textual level. In such a way it abstracts the consciousness of the text producer. Presumably different Agents have different functions in a text and have been chosen to give expression to what is subjectively conscious. A differential typological analysis of the Agent function can give information about which processes may be thought to operate in the manifestation of the cultural influence on consciousness.

Sweden

Any hierarchic grouping procedure produces dendrogram data. These can be represented in the form of a tree. The presentation of the tree as well as all other relevant information is usually too extensive, however, to be reproduced in an article. Because of this, we have chosen to give information about the groupings that are significantly different together with the values of the t-distributions and their confidence intervals. The rule used is Rule 1: Upper Tail Rule, which is reported in the CLUSTAN manual (Wishart, 1982, p 14-16). The way in which the test was applied is described in Bierschenk & Bierschenk (1986 c, p 12). The results are given in Table 2. Only configurations building on significant groupings which do not fall below the lower limit of the $t._{90}$ of the t-distributions are retained for topographic representation and further analysis.

The cognitive process of the Swedish workers and the structural relations contained in the Swedish text are presented in Figure 1. The background of the cube takes up the Figure component. At the base of the cube the relations pertaining to the

Ground component are visualized. The foreground represents the perspective on the Figure. The description will begin with the Figure component.

The edges of the planes represent the terminal states of the process. The first terminal state named Labourousness includes most of the information in the Swedish text. This concept is determined by the motivation of the workers, labour discipline, rest hours, number of working days, and salary claims. In particular it addresses the workers' concern with getting paid for the time units invested in their familiarization with service information. The next state initiating a short process is Techni-

Table 2. Levels of significance for Agent, Figure, and Ground components in Swedish material

Predicted Clusters(C)	Realized Deviates(a)	df	$t = \sqrt{C} \times a$ and Percentiles of the t-distributions	
	Agent N = 15, n = 52, m = .135, s = .323			
2	3.47	1	$t_{.90} < 4.91 < t_{.95}$	
	Figure N = 52, n = 15, m = .076, s = .240			
2	6.61	1	$t_{.95} < 9.35 < t_{.975}$	
3	.76	2	$t_{.80} < 1.32 < t_{.90}$	NS
4	.74	3	$t_{.80} < 1.48 < t_{.90}$	NS
5	.73	4	$t_{.90} < 1.63 < t_{.95}$	
6	.69	5	$t_{.90} < 1.69 < t_{.95}$	
	Ground N = 8, n = 2, m = .250, s = .661			
2	2.27	1	$t_{.90} < 3.21 < t_{.95}$	

Note: NS = non significant

The t-statistics with (C = cluster -1) number of degrees of freedom is computed by a multiplication of the deviations with the square root of (C -1). Wishart uses (n -1) where n = number of values on the optimizing function. A C-based instead of an n-based test value minimizes the problem of non-normality of the Error Sum of Squares.

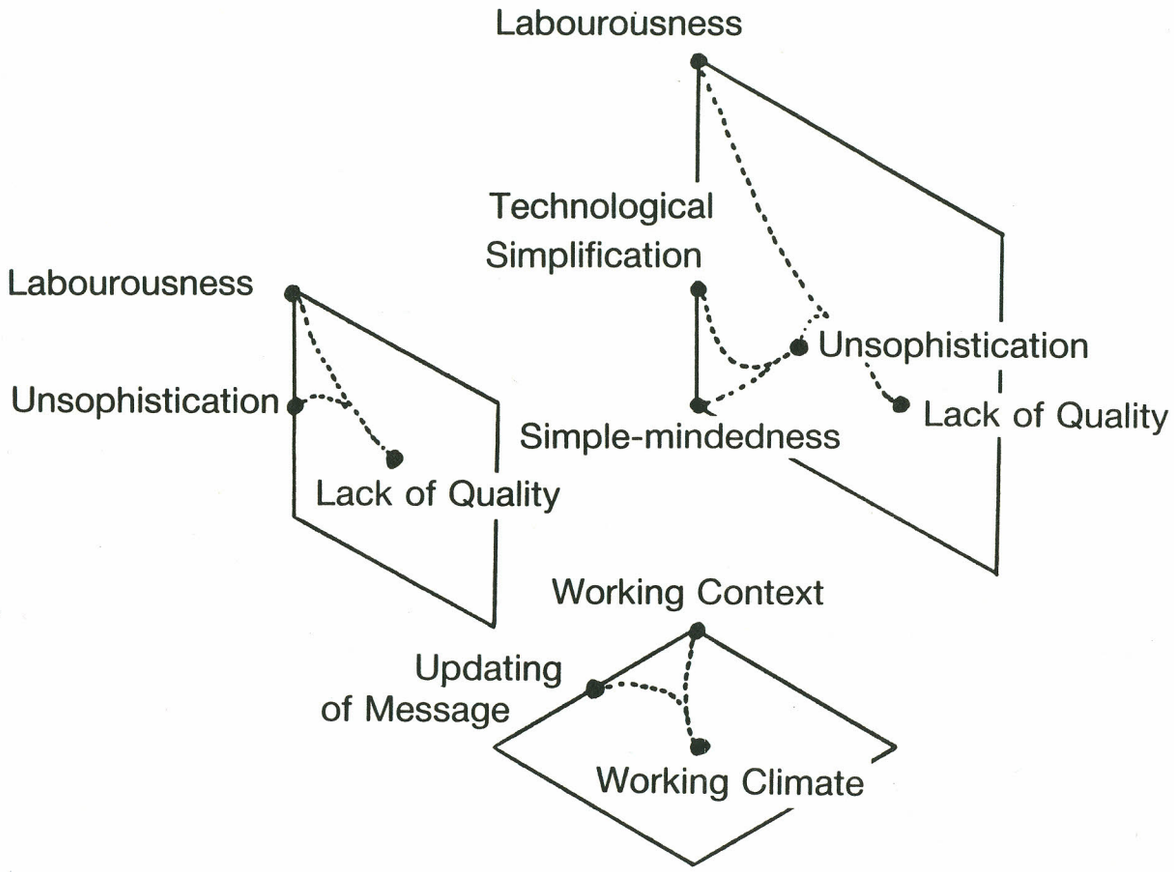

Figure 1. Operating structural relations characterizing perspective and viewpoints of Swedish mechanics. From " A cognitive economics approach to information management " by B. Bierschenk, I. Bierschenk, 1986, Kognitionsvetenskaplig forskning (13), p 7.

cal Simplification. This state gives expression to the demand for simplified instructions, i.e., instructions that can go into a pocket book. The process transits through the terminal state named Simple-mindedness, which stands for the effect of an expressed reluctance to invest efforts for reaching a certain level of technical qualification. The transformation results in the singularity of Unsophistication. This peak should be understood as the absence of refinement or a structured approach to instructional materials. This first step in the process is transformed by Labourousness, which produces the second and final singularity, Lack of Quality. The natural or essential character of the work or goods produced makes it probable that they will be of lesser standard than one would expect.

The perspective on the Figure extracts one singularity, which is Lack of Quality.

There is no perspective on the Ground. The Ground itself expresses a one-step process, which starts with the terminal state Working Context. It refers to the conditions at the working place, particularly substances polluting the environment, air conditioning, and cleanness. The second state, Updating of Message, refers to the import of being continuously informed about ongoing matters of value to the personnel. The transformation produces Working Climate as the only singularity in the Ground.

Conclusions. The results presented point towards the power of natural language in carrying on the integration of experience into a mental structure. It is obvious that this structure is quite rudimentary. The structural relations having emerged through the numerical analysis and graphical presentation show that Swedish workers are fairly unconcerned about information of technical kind. Moreover, the Ground component brings out a consciousness about ergonomic matters.

England

After the observations of the structural relationships characteristic of Swedish mechanics in relation to the questions of job related information, it would be of interest to study the subjective consciousness of their English counterpart. The signi-

ficant groupings of the numerical analysis are presented in Table 3. The table shows that six groupings have emerged, which means that there is more structure in the English text compared to the Swedish one. The cubic space containing this structural information is presented in Figure 2. The background of the cube takes up the Figure component. At the base of the cube the relations pertaining to the Ground component are visualized. The foreground represents the perspective on the Figure. The description will begin with the Figure component.

The edges of the planes represent the terminal states of the processes. The process of the Figure component starts in the state of Model Criticism. It basically addresses the criteria for the evaluation of the functional fitness of the Service Support unit of the multinational industry. Such criteria could be

Table 3. Levels of significance for Agent, Figure, and Ground components in English material

Predicted Clusters(C)	Realized Deviates(a)	df	$t = \sqrt{C} \times a$ and Percentiles of the t-distributions
	Agent N = 12, n = 49, m = .178, s = .349		
2	2.99	1	$t_{.90} < 4.23 < t_{.95}$
	Figure N = 49, n = 12, m = .103, s = .273		
2	5.69	1	$t_{.95} < 8.05 < t_{.975}$
3	2.05	2	$t_{.975} < 3.55 < t_{.99}$
4	1.71	3	$t_{.975} < 2.34 < t_{.99}$
5	1.22	4	$t_{.975} < 2.73 < t_{.99}$
6	.92	5	$t_{.95} < 2.25 < t_{.975}$
	Ground N = 13, n = 4, m = .263, s = .573		
2	2.87	1	$t_{.90} < 4.06 < t_{.95}$

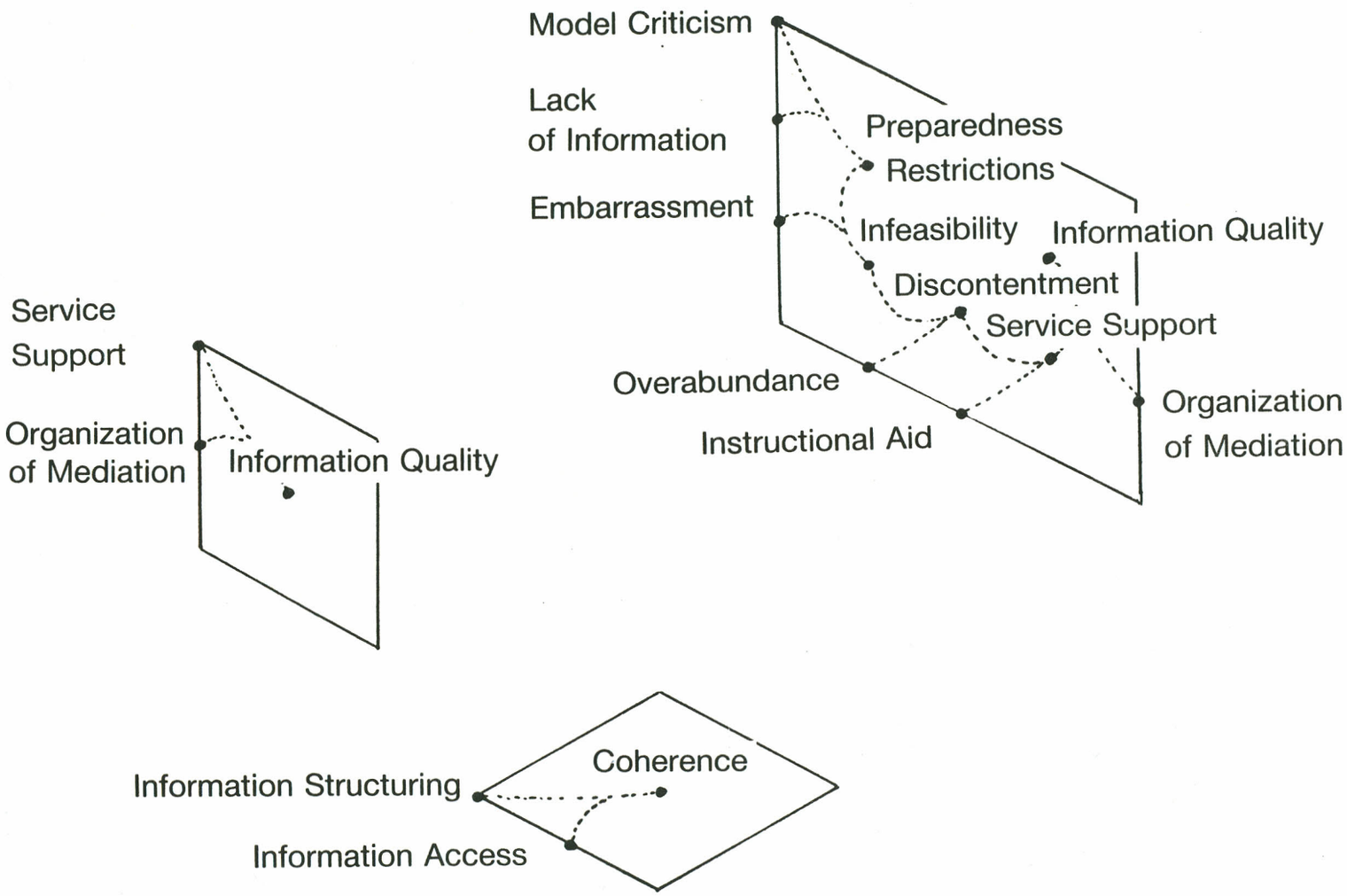

Figure 2. Operating structural relations characterizing perspective and viewpoints of English mechanics.

(1) Significance: denoting the preciseness and validness of the information with respect to the addressee's actual problems.
(2) Exactitude: asking for information that describes an innovation or modification reliably.
(3) Influence: requiring information that to a certain degree has impact on a particular worker's motivation and actions.

This state becomes transformed by Lack of Information, which addresses the extent to which disseminated information is structured to meet the information needs of a particular person or group. The result of this transaction is the first singularity, named Preparedness Restrictions. At this point, it becomes obvious that the workers seem to experience a vague or ill-defined conception of how to go about in finding a problem solution. It may also mean that they are searching for too much information or that they have acquired a habit of restricting their behaviour in such a way that the problem is conceived to be unsolvable.

The perocess transits in a next step into the state of Embarrassment, meaning a state related to the valuation of what can be performed and what cannot. This step produces Infeasibility. At this point a mental state is reached, which can be conceived as a conceptualized barrier towards carrying out service functions. From here the process transits through the state of Overabundance. This state indicates that required selection processes do not function as expected. The resulting sungularity is Discontentment. The stress at this point of the produced curve is on a feeling of resentment towards the company.

The process now leads to a transit through the state of Instructional Aid, which puts a heavy load on the personnel with the task to give Service Support. Service Support is the singularity which marks the import of determining the kind of information needed in carrying out particular tasks for specified purposes.

The final transition refers to the state of Organization of Mediation and results in the highest point of the curve, called Information Quality. Therefore it can finally be stated that

Service Support means the creation of information that necessitates continually ongoing retransformation processes which are prone to distortion.

Thus the root of the mental process depicted seems to concern a questionable quality of the information disseminated. This circumstance is further enhanced through the perspective on the Figure. Its focus is on Information Quality.

The Ground component is defined by two terminal states, Information Structuring and Information Access, leading to the singularity of Coherence. Information Structuring requires that the personal concepts of the information user be used in information management. Information Access refers to the time interval between requests for information and its availability. Coherence is the only singularity in the Ground and refers to the problem of judging the relevance and meaningfulness of the information provided through the system's performance.

Conclusions. The English workers are from a topical point of view mainly concerned with (1) inefficiancy of the Service Support unit of the company and (2) insufficient quality of the information provided. From a cognitive or mental point of view, their stress lies on the interface between the information provider and the user.

West Germany

Thus far the division of the subjects into specific groups has given an indication of a cultural way of seeing reality or constraining the phenomenon of information management. Based on this indication, we will now proceed with this kind of analysis and give a structural description of the mental processes as they emerge from the analysis of the German text. Table 4 presents the t-values and confidence intervals for the significant groupings. As can be read from Table 4, five terminal states are significantly different in the Figure component. There is also enough significant differentiation in the perspective components to extract at least one focal point. The structural information is graphically presented in Figure 3. While the English workers are concerned with Organization of Mediation, their German counterpart shows an initial interest in the Acquisition of Instruction. The

function of Instruction refers to a description of the conditions for learning, whereas Acquisition addresses the phase in the learning process that lies between the apprehension of information and the performance of a task. This is also the initial state of the process. From here the process transits through Service Key and produces the singularity High Quality Service.

One may design various learning conditions, the one addressed here requires a steering component (Key) that places the worker into the position of judging on his own his performances. A performance in itself does not make it possible to conclude that learning has occurred. Therefore, the key is necessary to show that there has been a change in performance. Consequently, High Quality Service point towards the worker's internal capability of accomplishement, that is, completing a service task successfully.

At the next step, the process transits through the state

Table 4. Levels of significance for Agent, Figure, and Ground components in German material

Predicted Clusters( )	Realized Deviates(a)	df	$t = \sqrt{C} \times a$ and Percentiles of the t-distributions
	Agent N = 34, n = 74, m = .065, s = .136		
2	5.47	1	$t_{.95} < 7.74 < t_{.975}$
	Figure N = 74, n = 34, m =.055 s = .137		
2	7.75	1	$t_{.95} < 10.96 < t_{.975}$
3	1.23	2	$t_{.90} < 2.13 < t_{.95}$
4	1.18	3	$t_{.95} < 1.88 < t_{.95}$
5	.84	4	$t_{.90} < 1.88 < t_{.95}$
	Agent N = 10, n = 15, m = .200, s = .250		
2	2.67	1	$t_{.90} < 3.78 < t_{.95}$
	Ground N = 15, n = 10, m = .171, s = .205		
2	3.06	1	$t_{.90} < 4.32 < t_{.95}$

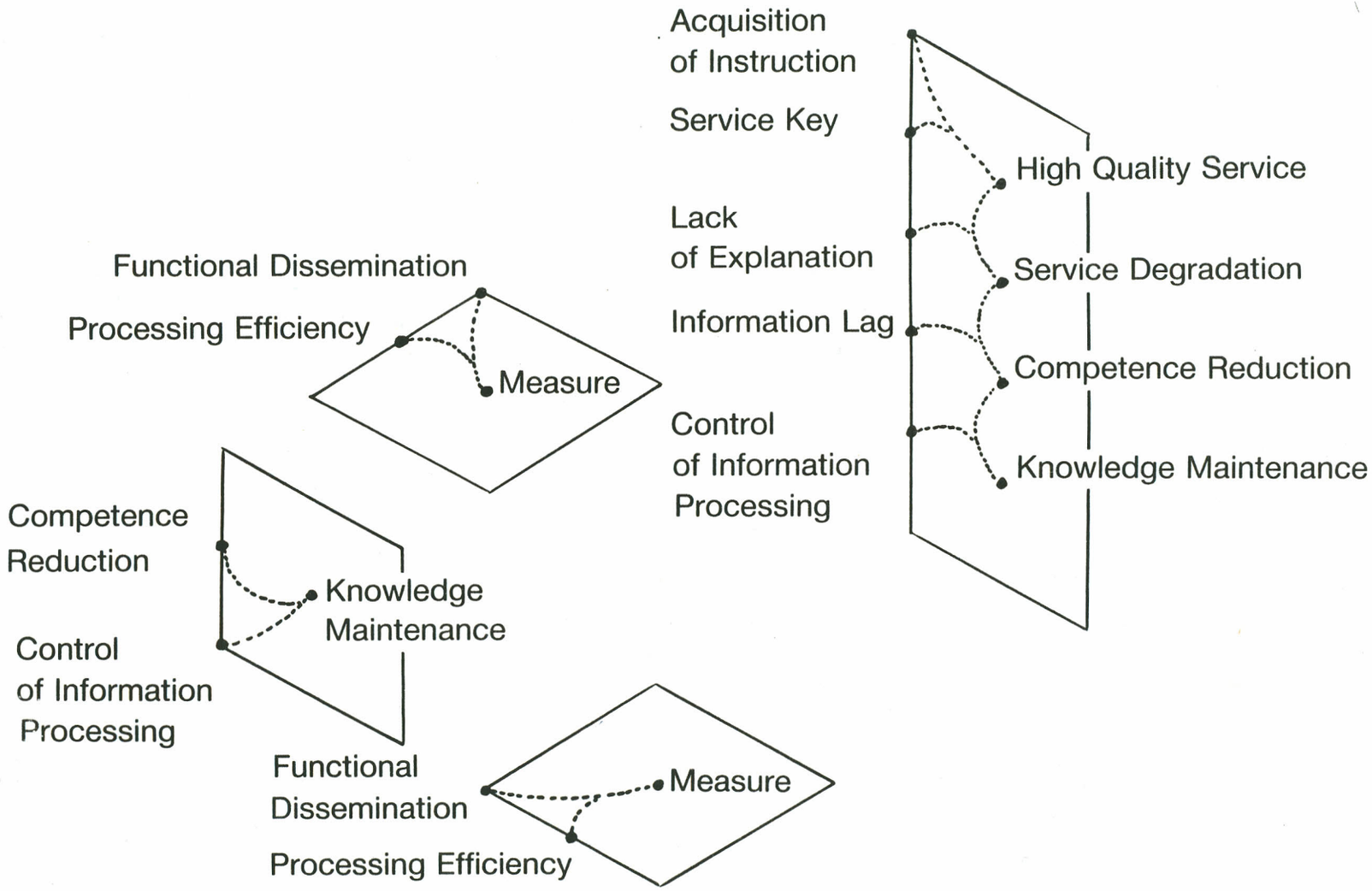

Figure 3. Operating structural relations characterizing perspectives and viewpoints of West German mecha-

named Lack of Explanation. When the worker is called upon to show what he has learnt or can put to use in some way, he must recognize the problem. This condition requires not only that he can differentiate between a variety of technical details and events which he has become familiar with in different contexts. What he needs above all is a conceptual, that is, an explanatory anchorage in order to solve some " odd " problem. Lack of Explanation gives expression to a need for a high level instructional language. The absence of such a language results in Service Degradation,meaning insufficiency in performance.

The next state is Information Lag, which transforms Service Degradation into Competence Reduction. Information Lag may be defined as a delayed feedback that produces an insufficient albeit negative change in mastery. To counteract this trend in cognitive development, the terminal state of Control of Information Processing transforms the process into its final state, Knowledge Maintenance. The demand for control implies a function of direction that seems to be of considerable importance to the learning process. What is asked for is a description of the mental performance expected. Knowledge Maintenance refers to the great value of preservation of concept and conceptual relations as a means for thinking and communication. The importance of this state cannot be overemphasized, but since concepts are verbally communicated, there is often a danger of loosing sight of their physical reality. Maintenance refers to the workers' need to know the real meaning of the concepts.

The emphasis on Knowledge Maintenance is further enhanced in the perspective on the Figure component.

The Ground contains the reason for the German conduct. It is defined by two terminal states, Functional Dissemination and Processing Efficiency. The first one refers to the importance of the dissemination of information to individual workers. The second one addresses the transformation of information into intellectual capability. The result is the singularity of Measure. Measure refers to a standard for comparison, which is necessary in determining hypothesized progression. It is important because

the Acquisition of Instruction by necessity is based on concepts and conceptual relations which require a means for analyzing the degree to which concepts are correctly referenced.

The perspective on a Figure or Ground picks up some abstraction, that is, some central aspects are focussed upon. It is of special interest here that the perspective structure of the Ground has been realizable. This gives additional weight to the importance of Measure in information processing.

Conclusions. The consciousness of the German mechanics points towards the problem of how information may be structured and represented in such a way that it fosters their development knowledgewise. The maintenance of knowledge is not only in the focus of their perspective but interrelated with a view on adequate measures controlling differentiation and structuring processes. For them the problem of knowing is not merely a question of permanent storing and retrieval, but rather seems to be a highly dynamic phenomenon. Thus knowing something cannot be considered a permanent attribute of the worker, which exists during his lifetime. It is restrained to a more or less extended time segment of his lifetime.

Italy

That the development of competence is highly dependent on the possibility to maintain and preserve knowledge either of the individual or of the company is clear from the last analysis. Attention should therefore be paid to the question of how training can be integrated into information processing. The text of the Italian mechanics contains some hints that an answer might be found there. The results of the numerical analysis show eleven significant clusterings in the Figure component. These are given with the clusterings of the Ground and the perspectives in Table 5. The edges of the cubic space show ten terminal states defining the Figure Component (Figure 4). The first terminal state concerns Modes of Instruction. The information environment consists of various communication media, which have to be arranged in such a way that they facilitate the performance of the workers. The specific arrangements at a particular working place comprise the Modes of

Instruction.

The cognitive process starts from the state of Learning Conditions. This state addresses a set of circumstances that obtain when learning occurs. In a broad sense, learning refers to certain observable changes in performance. This state is transformed when the process transits through Instruction and reaches Education. One might think of Instruction as a set of procedures designed to bring out transferability or inference. The aim is to integrate new information into previously learnt concepts and to make the concepts distinguishable from each

Table 5. Levels of significance for Agent, Figure, and Ground components in Italian material

Predicted Clusters(C)	Realized Deviates(a)	df	$t = \sqrt{C} \times a$ and Percentiles of the t-distributions
	Agent N = 20, n = 40, m = .111, s = .138		
2	3.65	1	$t_{.90} < 5.16 < t_{.95}$
3	1.29	2	$t_{.90} < 2.23 < t_{.95}$
	Figure N = 40, n = 20, m = .099, s = .175		
2	4.62	1	$t_{.95} < 6.59 < t_{.975}$
3	2.33	2	$t_{.95} < 4.04 < t_{.975}$
4	1.11	3	$t_{.90} < 2.22 < t_{.95}$
5	1.02	4	$t_{.95} < 2.28 < t_{.975}$
6	.79	5	$t_{.90} < 1.94 < t_{.95}$
7	.66	6	$t_{.90} < 1.75 < t_{.95}$
8	.53	7	$t_{.90} < 1.50 < t_{.95}$
9	.52	8	$t_{.90} < 1.56 < t_{.95}$
10	.49	9	$t_{.90} < 1.54 < t_{.95}$
11	.43	10	$t_{.90} < 1.43 < t_{.95}$
	Agent N = 12, n = 18, m = .167, s = .154		
2	2.96	1	$t_{.90} < 4.19 < t_{.95}$
	Ground N = 18, n = 12, m = .149, s = .177		
2	3.29	1	$t_{.90} < 4.65 < t_{.95}$

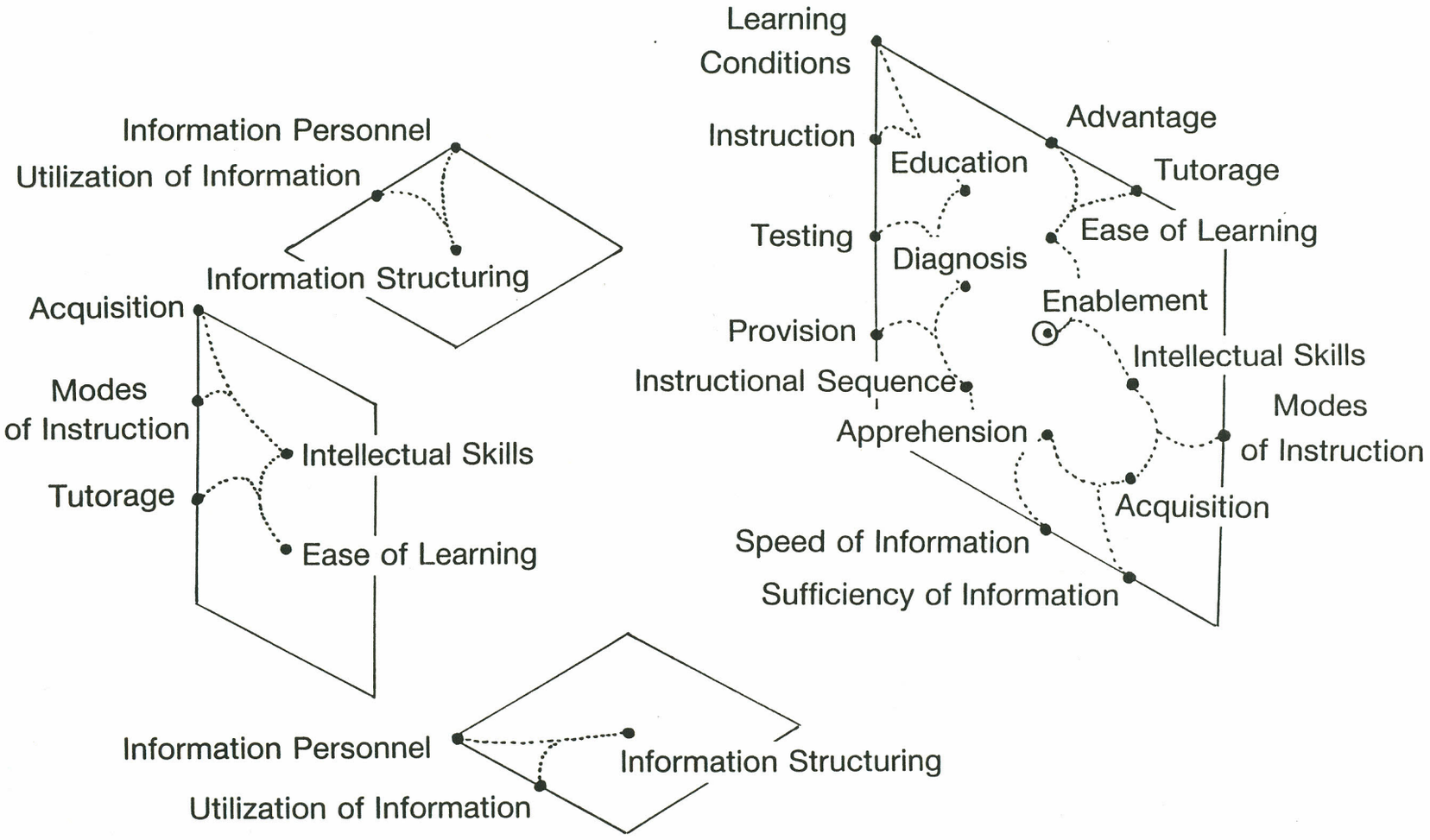

Figure 4. Operating structural relations characterizing perspectives and viewpoints of Italian mechanics.

other. Specific for Education is the requirement of a learning structure for the concepts or subjects to be acquired. Further, Education means a specification and ordering of the prerequisite capabilities within a certain topic.

The next following state is Testing, whose aim is to assess the outcome of an educational process. Testing in this sense can either mean assessing norm-referenced or criterion-referenced. The transition of the process through this state transforms Education into Diagnosis. Diagnosing the educational outcome norm-referenced implies that a distribution of scores is obtained from entire groups. On the other hand, criterion-referenced diagnosing means that the capability of a particular individual in attaining defined instructional objectives is assessed. Information Provision is the next state and requires that information is communicated in such a way that it can serve the particular purpose of instruction. The transformation brought out when the process transits this state produces the concept of Instructional Sequence. If concepts are being learnt, various kinds of information has to be provided in a well planned and orderly manner to gain the attention of the worker. The cognitive process now transits through Speed of Information, which allows the Instructional Sequence to be transformed into Apprehension. The Speed of Information controls the workers' possibility to attend to news and novelties. If it is timed properly, it will facilitate the perception. Although this " perceptual learning " is a necessity, Apprehension is required if what is perceived shall be conceptualized. Once Apprehension has occurred, the process leads over to the state of Sufficiency of Information, which transforms it into Acquisition. Before this specific event can occur, it is necessary to provide the workers with information that is both relevant to their task as well as concise and precise. The phase of Acquisition is terminated as soon as one can observe that a particular individual can execute the performance required. This state terminates the first cycle in the graph and initiates the second very short one.

From here the process leaps into Modes of Instruction, which

transforms Acquisition into Intellectual Skills. It is of import to realize here that an individual worker who has been called upon to exhibit a performance is placed in the position not simply to tell something but rather to do something. Thus Intellectual Skills require the instantiation of symbolic activities necessary for the performance.

The process goes on and leaps into its third and final cycle, which starts with the terminal state of Tutorage. By this is meant an interchange between a " student " and his " tutor ". Important for this interchange is the reading by the " student " that has been done before the meeting and that which will follow after the meeting. Thus the function of the Tutorage is to guide the " student's " thinking and to recommend the direction of further learning. This state is transformed when the process transits through Advantage into Ease of Learning. Strictly speaking, the Advantage lies in a management function and in the assessment of the "student's " performance. Ease of Learning addresses the questions the " student " can put to the " tutor ", because the answers provide the judgmental ground for engagement in self-directed study.

The third cycle now crosses the second point of intersection giving rise to the highest point in the graph, named Enablement. The circle around the node indicates that this concept has a higher depth in the mental structure compared to all the others. Enablement marks the circumstance that cognitive abilities function as mediators which enable the individual to interact with or interpret fairly discrete environmental experiences. Developing stable abilities and comprehensive knowledge requires productive learning experiences over an extended period of time. Thus the consciousness of the Italian mechanics can concisely be expressed in their willingness to extend their abilities.

The perspective on the Figure is a little more elaborated compared to the previous ones. In this context, the perspective transformation is not merely a displacement of viewpoints or a shift of the visual field, but a restructuring. Therefore, the graphical representation of the perspective gives expression to

a new structural connection, which focusses upon Intellectual Skills and Ease of Learning. These are lifted up from the Figure by the following routine. From the cluster analysis output the typology of the Agents is determined. The typology shows that Acquisition is the category name describing the Agent group that defines the initial state where the transformation process starts. The next Agent group is named Modes of Instruction. The highest point, that is, the singularity of the curve that connects both states is Intellectual Skills, which is extracted. The final significant Agent grouping is named Tutorage. The highest point between the singularity extracted and the last state defining the edges of the perspective is Ease of Learning.

One would perhaps expect that Enablement would be the focal point of the perspective. Why is this not the case? From the previous discussion of the Figure component it seems quite obvious that the Italian workers express an interest in rising their level of proficiency. Abilities, on the other hand, are more general and inclusive than Skills. It is the acquiring of Intellectual Skills that matches Ease of Learning.

The Ground component is defined by two terminal states, Information Personnel and Utilization of Information. The first state refers to a need for persons who can handle growing quantities of information. When the process transits through the second state, a transformation takes place that results in Information Structuring. This Structuring has to be accomplished on terms of the workers.

The point reached is further enhanced in that it is also the focal point of the perspective on the Ground.

Conclusions. Enablement is the root of the mental structure depicted in Figure 4. This concept stresses a quest for cognitive power. The central theme of this development is that abilities can be learnt. Consequently, it is of great importance to the Italian workers that efforts be concentrated on the development of their abilities, rather than putting efforts on striving for mastery of content in the instructional material, that is, for factual knowledge.

United States

The analysis of the verbal data derived from the text produced by the US mechanics has led to eleven clusterings. The numerical values for these clusterings are given in Table 6. The Table also shows two significant clusterings of the Agents related to the Figure component, while those related to the Ground component show four clusterings. The Agents of the Means component show no significant clustering above the chosen lower bound of $t_{.90}$ of the confidence interval for the t-distributions. The Means component itself shows two significant groupings. The realized collinear groupings of the US material is graphically presented in Figure 5. The discussion of the operating structural relations in the US material precedes in the same way as before. The only new information to be added for the understanding of the cube relates to the Means component. It is represented in the upper left part of the left hand side.

The cognitive process depicted in the background starts in the terminal state of Declination. The import of this state is that the amount of information delivered has been exposed to various forms of destructive tendencies. For example, the steering and controlling mechanism is conceived to be producing too much redundancy or failure in addressing the individual worker or in regulating the information fed back by the worker. Then Declination follows, which implies an information system whose functions are too clumsy to make possible a differentiated growth of information.

Personalization is the next state through which the process transits. The indication here is that humans like to be informed by humans. This type of information is perceived as being of considerable help. So this state transforms Declination into Enablement. From here the process leaps into Coordination, meaning that a particular person functions as a selector and instructor. If information is structured in such a way that interpersonal relations become used, it is conceived as the best information one can get. Especially novel information requires that the worker gets clear-cut instructions on how to treat it. The process now

develops into Constructiveness, a concept expressing a behaviour that involves the utilization of materials and tools in serving to be helpful. The state of Information Access transforms Constructiveness into Cognitive Operation. This is the ultimate mood for the conscious reformation of one's own abilities. Reasonableness directs attention to the consciousness

Table 6. Levels of significannce for Agent, Figure, and Ground components in US material

Predicted Clusters(C)	Realized Deviates(a)	df	$t = \sqrt{C} \times a$ and Percentiles of the t-distributions
	Agent N = 32, n = 112, m = .069, s = .134		
2	5.09	1	$t_{.95} < 7.20 < t_{.975}$
	Figure N = 112, n = 32, m = .058, s = .175		
2	8.58	1	$t_{.95} < 12.13 < t_{.975}$
3	3.33	2	$t_{.975} < 5.77 < t_{.99}$
4	2.35	3	$t_{.99} < 4.70 < t_{.995}$
5	1.97	4	$t_{.99} < 4.36 < t_{.995}$
6	1.69	5	$t_{.995} < 4.13 < t_{1.00}$
7	1.31	6	$t_{.99} < 3.47 < t_{.995}$
8	.71	7	$t_{.95} < 2.01 < t_{.975}$
9	.70	8	$t_{.95} < 2.10 < t_{.975}$
10	.70	9	$t_{.95} < 2.21 < t_{.975}$
11	.54	10	$t_{.90} < 1.79 < t_{.95}$
	Agent N 13, n = 36, m = .154, s = .237		
2	3.06	1	$t_{.90} < 4.33 < t_{.95}$
	Ground N = 36, n = 13, m = .117, s = .286		
2	5.05	1	$t_{.95} < 7.14 < t_{.975}$
3	1.79	2	$t_{.95} < 3.10 < t_{.975}$
4	1.00	3	$t_{.90} < 2.00 < t_{.95}$
	Means N = 9, n = 6, m = .278, s = .279		
2	2.06	1	$t_{.95} < 6.00 < t_{.975}$

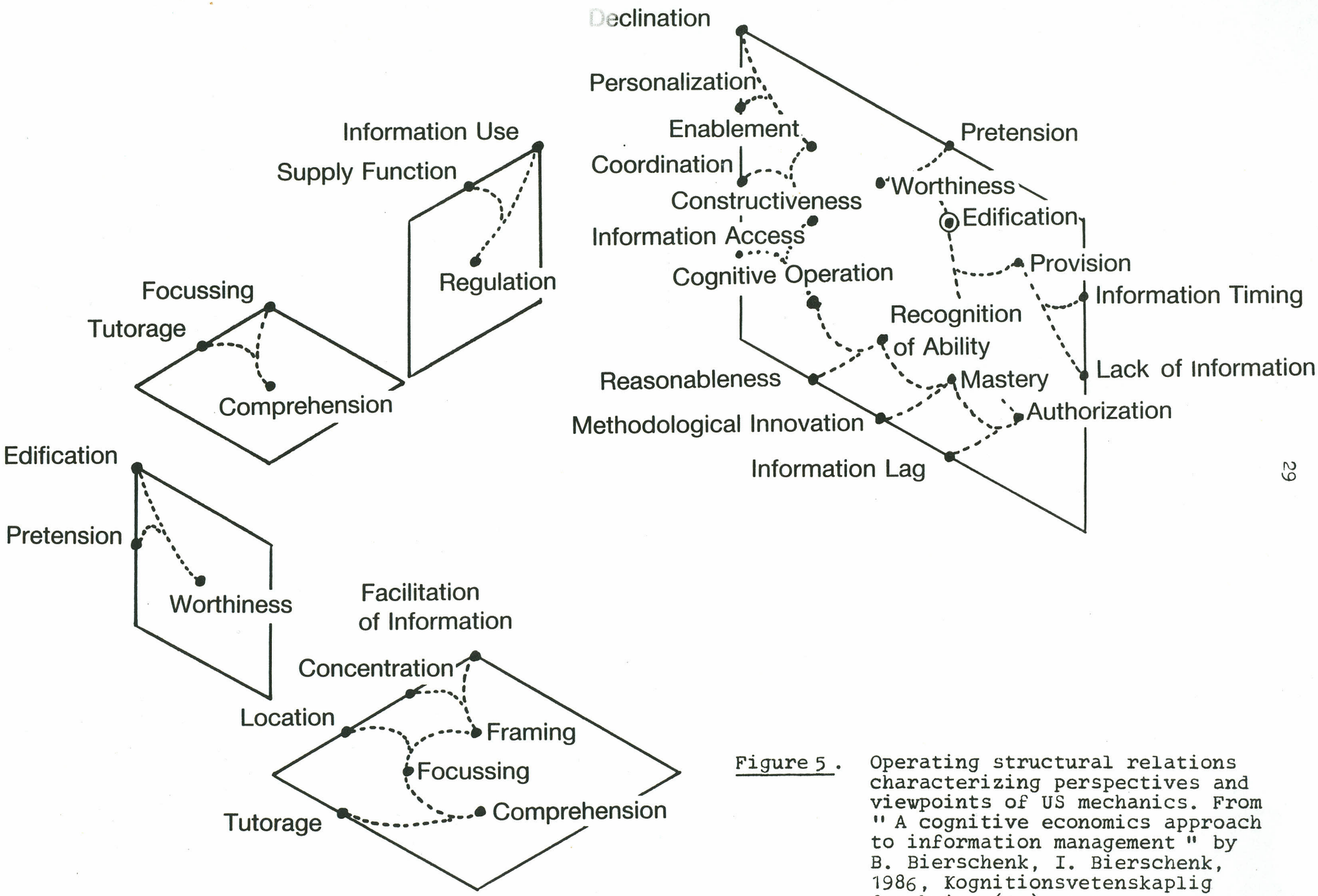

Figure 5. Operating structural relations characterizing perspectives and viewpoints of US mechanics. From " A cognitive economics approach to information management " by B. Bierschenk, I. Bierschenk, 1986, Kognitionsvetenskaplig forskning (13), p 5.

developed by the workers and the mental activities they have experienced. When the process transits through this state, it develops into Recognition of Ability. This singularity denotes a desire to pay attention to the consequences of the way in which information is disseminated. As a consequence, devices have to be devloped for an unbiased assessment of the workers' abilities. Otherwise misunderstanding and misinterpretation may result and render the company incoherent or even incomprehensible. However, through Methodological Innovation, this state can be transformed into Mastery. On the other hand, the workers seem to show estrangement because of Information Lag, which transforms Mastery into an insufficient Authorization. Thus at the highest point of the first cycle in the graph, the workers give expression to an interference with their possible achievement, which is an unsatisfactory state from their point of view.

From here the process continues into the first state of the second cycle, namely Lack of Information. An overabundance of information without any novelty tends to be conceived as missing. At the next step, the process reaches Information Timing, a state that may be regarded as a positive and compensatory regulation of this " system error ", resulting in Provision. This is also the peak of the second cycle. This cycle crosses the path of the first one with the effect of a deepening of the mental structure, indicated by a circle around the node named Edification. This concept may be conceived as a necessary means for increasing the subjective consciousness of the workers to facilitate an inner-directed change of their behaviour, instead of an outer-directed (speak company-directed) by behavioural modification. The process finally transits through the state of Pretension, which is determined by the ratio of actual behaviour to supposed behavioural potential. The transformation taking place results in the hihgest point of the entire curve, that is, Worthiness. Thus a conception of merit and respect has emerged as the root of the mental structure of the US mechanics.

This point is lifted up and focussed upon in the perspective on the Figure.

The transformational process depicted in the Ground is more

elaborated than in the previous Grounds. The process has one cycle, which shows a thematic development on efficient information management as foundation for competence development. The states defining the edges of the Ground, Facilitation of Information and Concentration, indicate that infrastructures may develop that require a certain Framing of information. Their Location implies that information is organized in a manner which appears alien to the workers. Only by developing integrating and interacting mechanisms a Focussing on required information will be possible. For these workers the only way out of this state is provided through the function of Tutorage, which transforms Focussing into Comprehension.

The perspective on the Ground lifts up and accentuates the highest point of this curve, namely Comprehension.

The Means component, finally, shows Information Use as the initial state. It indicates the importance of information in the comprehension process. The state of Supply Function transforms Information Use into Regulation, thus expressing a need for putting values on the presentation of information.

Conclusions. The textual transformations abstracted from the US material give expression to a willingness in solving service problems. On the other hand, the workers indicate that their ability is insufficiently recognized. Moreover, they bring out a self-consciousness in that service information is of concern for them. It is considered a necessity and as such an integrative part of their everyday life. They relate the challenge they experience directly to their Worthiness.

Discussion

In this article we have tried to show how coordinative structures are modulated by information coming from various cultural sources. We have tried to show that there exist subtle and mutually dependent relationships between textual Agents and their Objectives. Both Agent and Objectives provide structural information relevant to the linkage as well as to textual dynamics. The article presents five analyses which show that the grammar of lan-

guage does not uniquely determine the development of the theme. Each one introduces a novelty. Some of the characteristics that emerge are noteworthy.

The concept of consciousness, especially self-consciousness, has been studied by Sperry (1983). He defines consciousness as the emergence of a unity of mental experience in humans. This unity gets its expression in language with the help of an " I " or what is substituted for it in the verbal expression of alternative consequences of an action (Jaynes, 1976). On this basis it can be stated that the study of consciousness focusses upon the problems of everyday life. For the Swedish workers, this kind of problem is basically economic. They relate information use to their working load within the context of ergonomic conditions. The English workers seem to be conscious of the import of the mediation of information. For them, the quality of information is dependent on forms of distribution. Connected with it is their conception of coherence, which implies that attention is paid to the way in which various functions of the service support system interacts with their working environment. The consciousness of the West German workers demonstrates that they know how to acquire instructions. They can differentiate between correct and erroneous service by applying their personal system of concepts. But they are also conscious of the fugitive nature of knowledge, which calls for controls and measures in maintaining it. The question that concerns the Italian workers the most is mainly procedural in kind. For them, it is of import how a person's ability can be developed to discriminate between the right and the wrong alternatives in service tasks. It is of less import for them to structure information by their own. On the contrary, they ask for persons who can demonstrate how to chose the correct alternative. The consciousness of the US workers centers around the individual's responsibility at his working place. Every person is seen to have the responsibility for his actions, that is, becoming informed or having access to the latest developments within his field. This strong conviction puts a heavy stress on worthiness. The moral point of view places the US

worker in an advantage position, especially when one considers his desire for comprehension compared to persons who have been forced to give up responsibility or have not yet adopted it. The US workers' understanding of what has to be done is clear and direct.

References

Bierschenk, B. (1982). An ecological model for the processing of symbolic information. Perceptual and Motor Skills, 54, 663-674.

Bierschenk, B. (1984). Steering mechanisms for knowability. Kognitionsvetenskaplig forskning (1).(ERIC No. ED 264 246)

Bierschenk, B., & Bierschenk, I. (1976). A system for a computer-based content analysis of interview data. Lund: Gleerup.

Bierschenk, B., & Bierschenk, I. (1986 a). Concept formulation. Part I. The phenomenon of cognition. Kognitionsvetenskaplig forskning (10).

Bierschenk, B., & Bierschenk, I. (1986 b). Concept formulation. part II. Mesurement of formulation processes. Kognitionsvetenskaplig forskning (11).

Bierschenk, B., & Bierschenk, I. (1986 c). Concept formulation. Part III. Analysis of mentality. Kognitionsvetenskaplig forskning (12).

Bierschenk, B., & Bierschenk, I. (1986 d). A cognitive economics approach to information management. Kognitionsvetenskaplig forskning (13).

De Mey, M. (1982). The cognitive paradigm. Cognitive science, a newly explored approach to the study of cognition applied in the analysis of science and scientific knowledge. Dordrecht: Reidel.

Jaynes, J. (1976). The origin of consciousness in the breakdown of the bicameral mind. Boston: Houghton Mifflin.

Pribram, K. (1986). The cognitive revolution and mind/brain issues. American Psychologist, 41, 507-520.

Sperry, R. (1983). Science and morality priority. Oxford: Basil Blackwell.

Ward, J.H. (1963). Hierarchical grouping to optimize an objective function. Journal of American Statistical Association, 58, 236-244.

Wigner, E.P. (1969). Epistemology of quantum mechanics: Its appraisals and demands. In M. Grene (Ed.), The anatomy of knowledge (pp 31-45).

Wishart, D. (1982). Clustan: User manual. (Inter-University Research Council. Series No. 47). Edinburgh: Edinburgh University, Program Library Unit.

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